

How do apes think? This scientist is trying to get into animals' heads

Chimps have been observed hiding objects in order to throw them at people later, but some gorillas are unable to identify themselves in a mirror. Tel Aviv University Prof. David Eilam talks about the sharp scientific debate over 'theory of mind' in animals

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You're a zoologist, but your area of research sounds like it's a little less conventional. Tell me something about what you do.

I study cognition in animals, a field which, I am very happy to say, has been constantly developing in recent years. My work primarily deals with the organization of behavior in space and time: how an animal actually knows where it is and where it is going.

Let's talk about a particularly complex aspect of cognition, namely "theory of mind." In a crude abstraction, this term refers to the ability to attribute mental states to another and, accordingly, to predict his responses and behavior.

Theory of mind refers to the ability to enter into the head of the other and to understand what's going on there. It starts from knowing ourselves, our aspirations and our passions, and then realizing that the other also has aspirations and passions and intentions and knowledge and perspectives that might be very different from ours.

It's a multifaceted ability that is difficult to discern in human beings, let alone animals.

But we humans have the advantage of simply being able to talk about it.

That is also a well-known question: whether intelligence exists in the absence of language.

Many years ago, when the discussion of cognition in animals had just begun

and scientists were wondering how to examine it, the first thought was to teach animals language. Attempts have been made, especially with chimpanzees, to teach them a [verbal] language or a sign language, because it was assumed that for them to possess mentalization capability or intelligence, they would need the ability to cross-check information by means of language. It was only afterward that it was understood that language need not be human language. Birdsong is language. A scent trail is language. Facial expressions are language.

That's interesting as a question of principle, but what is the practical importance of proving theory of mind in animals?

The whole basis of misunderstandings and conflicts in our lives – from the Israeli-Palestinian conflict to quarreling with our partner – is that we perceive and understand situations differently. Think of animals that hunt together. I am always thrilled anew whenever I see a pride of lionesses setting out for the hunt. They actually convene a sort of war council; each knows which way she is supposed to go and the role she is to play. It is truly an astonishing sight, which necessitates an understanding or insight about what my role is and what the other's role is.

And also where I begin and end, and where the other begins and ends.

Definitely. Because if one lioness doesn't understand her place and role within this constellation, and she decides to leap in the wrong direction – she will ruin things for all of them. An understanding of social hierarchy is related to this: If I am an inferior male and I approach an alpha male and hit him, I will be roughed up. To know what others know or understand is a critical ability for social animals. The thing is that when we talk about what animals understand and know, or don't understand and don't know, we are actually referring to the entire range [of beings] – from unicellular creatures to chimpanzees, who are almost identical to us genetically.

Could you explain a little about the first study of theory of mind in animals, the pioneering research that launched the field?

In 1978, scientists published an article stating that theory of mind exists in animals. In experiments they carried out, they showed a chimpanzee named

Sarah who was shown video clips that presented her with a certain problem – let's say, a person who wants to reach a banana on a table but whose hands are too short – and then a series of pictures. She was “asked” to choose the picture that would seemingly contain the solution to the problem she saw in the clip. Well, in the case of a person who stretched as far as he could but couldn't reach the banana, she chose a picture of a stick. When she was shown a clip of a person standing in a room next to a heater that was turned off and a person shivering with cold, she chose the picture of a burning match.

But then the researchers themselves recanted their conclusion.

Yes. A few years later they published an article in which they reversed themselves. They wrote, for example, that Sarah had apparently only looked at the heater and chosen a picture that suited it, without any understanding that the person was shivering from cold; or that she chose the stick as a means to get to the banana only because it was placed in a particular way in the picture.

This is a widespread phenomenon in the field, no? A real pattern. Every study that is published immediately generates attacks by other researchers, who are convinced that the new study is mistaken, that the interpretation is biased, that the animal's behavior is merely an imitation or a response to hints from the experimenters.

The phenomenon is so widespread that it has a name: “killjoy.” Those who ruin the joy of the discovery and the accomplishment. There are three schools of thought in the realm of cognition in animals. There are the detractors, who are always looking to show why it's possible to explain animals' behavior in completely different ways; the preachers, of whom I am one, for whom everything constitutes overwhelming proof that animals have the ability to mentalize; and those in the middle, who say: Let's accumulate more knowledge and see whether it really can be proved. By the way, the more knowledge we accumulate, the more we see that the ability to possess theory of mind does in fact exist.

But there is no consensus, nor can there be.

Among the reasons there can be no consensus is the fact that animals are so different and diverse, and also the fact that theory of mind itself is so diverse. Just recently a large survey article was published whose bottom line is that the phenomenon is multifaceted and that certain aspects of it do in fact exist in animals, in a way that can be proved clearly. The only consensus is that it does not exist in animals in the way it exists in humans. There is no animal that displays the whole range of abilities.

Let's talk about the experiments themselves. I admit that it was difficult for me to read about them.

A painful problem. Today, it is almost completely forbidden to confine chimpanzees in order to perform experiments. Fortunately, things that were done to monkeys in the past, such as physically damaging their brains, or raising them in conditions that affected their development, are prohibited today, and that's all for the good. Awareness of animals' welfare, both among the public and in the scientific community, is higher than in the past, and supervision is strict. In my research, at any rate, I only photograph them, no more than that.

Most theory of mind experiments on animals are really variations of the cognition tests that are done on children and infants, either in the autistic or the developmental context. Especially what's known as the "Sally-Anne test."

That test was developed by Prof. Simon Baron-Cohen, an uncle of [actor] Sacha Baron Cohen, together with two other scientists whom it has been my privilege to work with. The original experiment looks just like a play, with two puppets, but the principle is simple: Children watch two experimenters playing with a certain object – a ball, let's say. One of them puts the ball in a basket and leaves the room. While he's out, the second experimenter removes the ball from the basket and puts it in a box. When the first experimenter returns, the children are asked where they think he will look for the ball. Younger children, in whom theory of mind is not yet developed, or children who are on the autistic spectrum, will point to the box.

Because they think that everyone sees what they see. They don't understand that the person who left the room could not have seen the object being

moved.

And that is exactly theory of mind. To leave your own situation and enter another situation, one that someone else is in. There is a very impressive experiment, which was published a few years ago, that's been nicknamed the "Tale of a Scientist, a Stick and King Kong." In the experiment, apes sat in front of a screen and watched a film in which a person dressed up as an ape goes over to a scientist working in the yard, hits him from behind and then runs away and hides behind a bale of straw.

The scientist who was hit goes inside for a few seconds and then comes back out. In his absence, the person disguised as the ape emerges from behind the bale of straw and hides behind a different bale. In the meantime, the scientist comes back out, armed with a stick, and the question is where the viewers [the apes] expect him to look. The scientists simply monitored the animals' eye movements, in order to understand which bale they expected him to approach. The result was that the apes understood that the scientist didn't know that King Kong had switched his hiding place.

That is apparently the only experiment for which a certain consensus exists. It was even hailed by [the primatologist] Frans de Waal.

It's an impressive achievement and a smart experiment, but I, for one, was less persuaded after viewing the clips. They are on the web, with the apes' eye movements shown by markings. It's not that the apes are looking only at the straw bale – they're looking at all kinds of places. They may pause a bit longer at the bale, but they are not looking only there. And because I suppose that the clips they released are the best they have, I'm a bit skeptical as to whether this constitutes overwhelming proof. Again, there is always the risk that we are simply falling into the same trap – of our inability to understand how things are interpreted from the animal's perspective.

I'll give you an example. There is a very simple experiment in which two containers of food are placed in front of an animal; the experimenter points to one of the containers, and the animal is expected to go to the container that was pointed to and eat from it. This experiment simply did not work with elephants. For many years scientists tried to figure out why – given that

elephants are intelligent animals – and then, by chance, a mistake occurred in one of the trials. The experimenter was supposed to be in the middle, between the two containers, but stood closer to one of them. It then turned out that the elephants weren't interested in the container the experimenter was pointing to, but in the one he was closer to.

Again we have to wonder about the relevance of such experiments to the animal's everyday behavior, and why it is supposed to know or not know [something]. Do animals in nature have dealings with food containers? Are apes used to sharing knowledge about which box an object has been hidden in?

The question about whether the animal needs that ability is of importance. And therefore, for every test like this, it's necessary to understand whether it is ecologically valid – whether the animal has any need for what we are about to test.

Besides that, almost all these experiments were conducted on animals in captivity. That is obviously a very significant factor.

That is one of the strongest arguments against all the studies of cognition in animals. The animals that take part in these experiments are completely different from the start. They grow up in the company of humans, they are used to humans' behavior, to their culture, to their way of thinking. For example, there are many experiments that examine the use of tools by animals, and the argument against this is that these animals actually acquire the skills to use tools by observing humans. Again, the testimony is always contradictory.

There is an experiment in which mirrors were placed in front of gorillas in a cage in the zoo. After 400 hours, they still had not succeeded in understanding that it was them in the mirror. In contrast, when the trainer of the famous gorilla Koko showed Koko her reflection in a mirror, she pointed to herself and said [in sign language], "It's me, gorilla." The environment is tremendously important: A gorilla in a zoo, who never saw a mirror in her life, will not be able to identify herself, but a gorilla like Koko, who grew up in the company of humans, was.

Let's talk about a particularly interesting aspect of theory in mind in animals: cheating or deception. In other words, not only do I aspire to understand what the other thinks, I also aspire to change it.

We call this intentional deception. Overall, nature works so there won't be too much of this. Exaggerated deception endangers nature.

Are all the camouflage efforts considered deception?

Yes, but there are different degrees. If all snakes were to pretend that they are poisonous, that would be pointless. But those forms of behavior do exist. For example, there are roosters that make a sound as though they have found food; when hens hear the call and come to eat, the roosters will try to copulate with them.

It actually has to do with a conflict of interest. The deception will appear between predator and prey, between an animal that has food and an animal that doesn't.

Indeed, and in many behaviors of this kind there is an element of planting thoughts in the other's head. What's hard to evaluate is intention. Take, for example, what's known as "injured-bird behavior." That's seen mainly in species that nest on the ground and whose eggs are exposed to predators. When a predator approaches the nest, the bird begins to skitter around with one wing hanging down. The predator sees that the "injured" bird represents a better chance of a meal. It draws the predator farther and farther from the nest, and then spreads its wings and flies off. Another case is the opossum, which pretends to be dead when it's caught by a predator, and because most predators prefer live prey, they leave it – and after a few minutes it escapes.

But that is not deliberate; it is not intelligent behavior.

No. It's a biological phenomenon. It's not related to intelligence – it's behavior, probably innate, that is manifested in situations of being exposed to predators, and there is no learning or thought involved.

There are also testimonies of deception that appears to be calculated, correct?

There is a quantity-based study, with proper control groups, that was conducted among males of the topi, an antelope that lives in Africa. The males take territories for themselves, while the females move about in groups between the territories, and when they encounter a male to whom they are attracted, they stay in his territory. If a female in heat in the territory of a male shows signs of intending to leave, the male immediately starts to emit warning sounds about approaching predators. The female naturally stops at once, and then he tries to copulate with her.

The study shows that in this way the male earns three chances to copulate that he wouldn't have had were it not for the deception. What is truly interesting is that he will not make these sounds if the female is not about to leave, when she is not in heat, and not even in a case of true danger, when a predator is actually approaching. This is deception per se.

Are there experiments that have examined deliberate deception in the laboratory?

I don't know of any, but there have been observations of deliberate deception by animals in captivity, such as among research colonies of chimpanzees. They are not controlled experiments but anecdotal observations. For example, chimpanzees that hid objects in order to throw them at those who were observing them; or chimpanzees that escaped from their cage in the university, looted the cafeteria and then returned to their cage and shut the door, as if to say they had nothing to do with it.

In one chimpanzee colony, there were grapefruits scattered in the yard, some openly and others hidden in the ground. There is a very clear hierarchy among chimpanzees – the dominant ones have first and full access to food, while the lesser ones approach the food only afterward, or need to “butter up” the dominant ones in order to get permission to approach.

The chimpanzees were taken to the yard with the grapefruits, and one of the less important ones was seen passing nonchalantly by the grapefruits that were hidden in the ground. There is no doubt that he saw them, but he didn't do anything. He waited for the dominant chimpanzees to eat until they were sated and had lost interest in the grapefruits, and only then did he go to the

buried ones and eat them. He apparently understood that if he tried to eat them right away, the dominant males would snatch them, so he preferred to wait for a propitious moment.

Can these anecdotes really attest to the existence of theory of mind?

Anecdotes have a certain value, because they accumulate to a point where there's a certain quantity that supports the existence of theory of mind. It doesn't bother me so much that these are anecdotes, what bothers me more is that often they lead to an interpretation of behavior that could be a reasonable explanation, but is not a proven one.

It looks like an impossible mission. The ability is so complex. The experiments are created on the basis of human cognition. In fact, our perception, being human, is limited. We will always tend to anthropomorphize animals. It's difficult to achieve clear-cut findings, and even successful cases are easily refutable. Will it ever be possible to get to a bottom line?

I believe it will be. All in all, we are constantly improving our methods. The limitation of our gaze upon animals is not always a drawback. It's true that we tend to anthropomorphize them, and we need to be careful of that, but we are aware of this, and in many cases it actually helps us to understand the behavior, to understand what we are seeing. The field of intelligence in animals is flourishing. This is its golden age. It has long since left the custody of the zoologists: Researchers from the fields of anthropology, psychology, philosophy and other disciplines have joined.

About a hundred years ago, a scientist who was working on rats in mazes put forward the idea that rats and humans have a cognitive map. The idea is that no matter where you are, you have an inner map or picture of your immediate surroundings. That was a completely abstract idea, which seemed disconnected from reality, but not long ago scientists who discovered the brain cells that are responsible for mental representation won the Nobel Prize. In other words, it has become an undisputed physical reality. To that progress we also need to add technological development. When I entered university, video cameras were rare – we had only one in the whole

university. The tools are becoming increasingly sophisticated and we are accumulating ever more knowledge – so I allow myself to be optimistic.